

## 1.0 PROGRAM OVERVIEW

The King County Wastewater Treatment Division of the Department of Natural Resources (King County) and Washington State Department of Natural Resources (DNR) apply biosolids as a forest fertilizer to selected acres in the state forests of King County as part of the Mountains to Sound Greenway (MTSG) Biosolids Forestry Program. These areas include: Marckworth State Forest, Tiger Mountain State Forest, and other parcels owned by DNR on Rattlesnake Mountain and in the watersheds of the Raging River.

Biosolids are the nutrient-rich product of the municipal wastewater treatment process. They have been used for more than 20 years in western Washington as a fertilizer and soil conditioner, improving the growth of forest and farm crops, as well as providing organic material for compost and reclamation projects. King County has used biosolids, under the trade name Silvigrow, since 1987 on the Snoqualmie Tree Farm, in collaboration first with the Weyerhaeuser Company, later with Hancock Forest Management when forest ownership changed.

The purpose of biosolids forestry projects is to use biosolids for forest fertilization and ecosystem enhancement. Forest stands selected to receive biosolids may include thinned timber stands, juvenile plantations, and young planted clear cuts.

The MTSG Biosolids Forestry Program was established in 1995. It is currently a partnership of the following private and public interests:

- Mountains To Sound Greenway Trust (MTSGT)
- Washington State Department of Natural Resources (DNR)
- King County Wastewater Treatment Division (King County)
- University of Washington College of Forest Resources (UW CFR)
- Hancock Timber Resources Group

The key elements of the program include: WDNR and Hancock will use biosolids to fertilize their forestlands; King County will manage the applications in accordance with all federal, state and local regulations; the University of Washington will be the program's technical advisor, responsible for approving sites for application, prescribing a nitrogen application rate, and approving each project's design and monitoring plan; MTSGT will lead community outreach and education programs. In addition, King County will fund the purchase of forestlands in the I-90 corridor, which will be added to the state forest system. King County, with savings generated by the biosolids forestry program, will provide funding and biosolids compost for MTSGT to use in restoration and greening of hillsides along the I-90 corridor and for environmental education programs.

The primary goals of the partners in the MTSG Biosolids Forestry program are to preserve and enhance forests in the I-90 corridor and to improve water quality and tree growth by recycling biosolids as a forest fertilizer. A copy of the agreement between the partners can be found in Appendix E.

## **2.0 PROJECT DESCRIPTION**

This plan provides an overview of biosolids operations in state forests and describes how operations are to be conducted.

Application of biosolids to state DNR forests began in the fall of 1995 with fertilization of a 20-acre Douglas-fir plantation in Tiger Mountain State Forest. In the summer and fall of 1996, another small plantation on Tiger Mountain received biosolids as well as 200 acres of Douglas-fir plantations in Marckworth Forest. In 1997 and 1998 the program continued in Marckworth Forest, and added application areas on Rattlesnake Mountain. Since that time, the focus has been on Marckworth Forest because this is where state forestlands have proven most suitable for biosolids fertilization. New DNR lands in eastern King County may be added to the program as appropriate.

### **2.1 Location**

Tiger Mountain State Forest is located 20 miles east of Seattle, in a triangle created by three major roads: Interstate 90, State Road 18 and the Issaquah-Hobart Road (see map in Appendix A). Marckworth State Forest is located in the Snoqualmie River basin in eastern King County, directly east of Duvall. The 12,000-acre block extends across the Snohomish County line on the north and is bordered by the Snoqualmie Forest on the east and south. The state also manages about 1,600 acres in scattered parcels on Rattlesnake Mountain, across Interstate 90 from the city of North Bend. The Rattlesnake Mountain parcels are bordered by State Road 18 on the west and by the Cedar River Watershed on the south. Rattlesnake parcels are reached from SR-18, near its intersection with I-90.

### **2.2 Transportation and Access**

Biosolids will be transported to project sites by a private firm, Great Western Soil Conditioners, under contract to King County's Biosolids Management Program. The transportation contractor will follow appropriate routes to each application site as determined by King County and DNR.

Tiger Mountain. The designated haul route follows I-90 east from Seattle past the town of Preston then south along Highway 18 to the summit entrance of Tiger Mtn. State Forest. Haulers must be alert for vehicles, mountain bicycles and hikers on the roads of Tiger Mountain. The main entrances are gated and locked, but there are some permitted vehicles that use the roads. Where needed to ensure safety of other road users, DNR and King County may use flaggers, detours or road closures to separate biosolids truck traffic from recreational users of the forest.

Marckworth Forest. Unlike Tiger Mountain, Marckworth Forest has a gravel county road, Stossel Creek Road, that is open to the public and that runs north-south through the forest. This road is also used for daily access by at least two families who have residences in inholdings in the forest. Haulers must be alert to these residents, as well as recreationists. All logging roads branching off Stossel Creek Road, however, are gated and locked. Gravel trucks or log trucks from other operations going on in the forest may also use these roads.

The haul route from the Renton Treatment Plant follows I-405 to I-90 to the Preston Exit. Then, north on Preston-Fall City Road to SR-203, north to Kelly Road NE, north to Stossel Creek Road NE (gravel) and into the state forest on gravel logging roads to the application sites. This route will require trucks to cross Harris Creek Bridge #5003, which prior to 2005 had a weight restriction, but is being rebuilt summer 2005. Empty haul trucks returning to the South Treatment Plant will travel Stossel Creek NE to Kelly Road NE, south to SR-203, south to Preston-Fall City Road, to I-90 and I-405 to Renton. At times, construction activities require trucks to follow detour routes, such as planned re-construction of Harris Creek Bridge.

Rattlesnake Mountain. Biosolids trucks from the South Treatment Plant in Renton will take I-405 to I-90, then south on SR-18 for less than one-quarter mile, then left through a locked gate onto Weyerhaeuser's Rattlesnake mainline logging road and via company logging roads to the application sites. Weyerhaeuser's roads are open for company and contractor business uses only, but the general public can purchase entry permits for use on weekends and late afternoons, so there may occasionally be some vehicle traffic on these roads.

## **2.3 Geology/Hydrology**

Tiger Mountain State Forest has mountainous, glaciated topography, with elevations ranging between 200 and 3,000 feet. It comprises a significant portion of the Issaquah Creek drainage, and consequently, a large portion of the watershed of Lake Sammamish. Some parts of Tiger Mountain also lie within the Raging River basin.

The topography of Marckworth Forest was formed by repeated continental glaciation, resulting in level to undulating plains of glacial drift over indurated till, interspersed with smoothed glaciated hills (Webster and Steinbrenner, Soil Survey of Snoqualmie Falls Tree Farm, 1974). Elevations range from 600 to 1,200 feet. The Marckworth area has four major stream systems:

- Stossel and North Fork Creeks, which originate in the northern part of the forest and flow south to the Tolt River (tributary to the Snoqualmie);
- Cherry Creek, which flows along the north and west sides of the forest and then into the Snoqualmie River;
- Harris Creek, at the south edge of the forest, empties into the Snoqualmie River.

Tiger, Marckworth and Rattlesnake have similar climates. The average annual rainfall is about 60 inches/year with 75 to 85 percent occurring during the wet season from October to March. Occasional snowfall is common December through February, with maximum accumulations averaging about 6 inches (TMSF Management Plan, 1986).

Because of similarities in geology and climate, the state forests have similar soil types. The dominant types are formed from residual bedrock or glacial till. Most of the areas suitable for biosolids are the lower elevation, gentler slopes that are till soils; they are productive but moist during much of the year, precluding the use of heavy equipment during the wetter months.

All the state forests in King County have streams, lakes and wetlands scattered throughout them. Because of these sensitive areas, biosolids application rates and management practices are designed to prevent nitrogen or other biosolids constituents entering nearby surface waters or watercourses. Individual unit maps in the appendices identify any surface waters within the project area, including those that may not be shown on DNR stream type maps.

## 2.4 Permits and Public Involvement

Biosolids are applied by ground vehicles, and so are classified by the DNR as a Type 2 forest practice, which requires a forest practices permit. The use of biosolids on land is regulated by the Washington State Department of Ecology under WAC 173-308 Biosolids Management, which has adopted the requirements of the U.S. Environmental Protection Agency (40 CFR 503). Ecology's Biosolids Coordinators ensure that projects follow state and

federal biosolids rules and state Biosolids Management Guidelines (2000).

Project partners attempt to provide the local public with project information; they encourage comments and suggestions. The MTSG Trust has taken the lead in notifying neighbors, environmental and recreational user groups. They have provided press releases and tours to local newspapers. Where organized citizen groups are present, MTSST, King County and DNR have provided information specifically to them, for example, to the Tiger Mountain Citizens' Advisory Committee.

King County has fulfilled the State Environmental Policy Act (SEPA) and its notification requirements. An environmental checklist and Declaration of Non-Significance (DNS) was issued for Tiger Mountain in August 1995 and Marckworth Forest in July 1996. An addendum for Marckworth Forest was issued in July 1998. In July 1997, under new county SEPA regulations, the county's Environmental Planning section released an environmental checklist and DNS for Rattlesnake Mountain/Raging River biosolids projects. Notices were sent to the twenty nearest property owners. During the comment period a large notice board was posted along SR-18 at the entrance to Weyerhaeuser/DNR Rattlesnake lands. King County has also met the public notice requirements of the Statewide General Permit for Biosolids Management, including posting of new sites for 30-days prior to application.

## **2.5 Roles and Responsibilities**

DNR, King County and the University of Washington are responsible for jointly selecting appropriate sites for biosolids applications. King County has the lead responsibility for site preparation, design, permitting, operations and monitoring, with DNR and University of Washington's review and approval. A list identifying the King County project team and each team member's roles and responsibilities can be found in Appendix B. All site design and operating plans are subject to DNR approval, particularly with respect to haul and transfer routes within the road system of the state forest. DNR retains the overall responsibility for managing the timber to meet its objectives and trust responsibilities.

## **3.0 BIOSOLIDS CHARACTERISTICS**

Biosolids are the nutrient-rich organic recyclable product of municipal wastewater treatment. At the treatment plant, after solid material is separated from wastewater, the solids are "digested" by beneficial microorganisms in large tanks at temperatures of about 97-98°F for 3 to 4 weeks. The process of digestion produces a stabilized dark, organic material (generally less than 5% solids), known as biosolids. This material is processed further, by dewatering in centrifuges to

approximately 25% solids and 75% water. This semi-solid material has a consistency much like damp peat moss and has a mild ammonia odor. King County biosolids are considered high quality, meeting all federal standards for beneficial use on land and crops.

For biological and chemical analysis of King County biosolids, see the latest annual *Biosolids Quality Summary*, which is available from the King County Biosolids Management Program.

### 3.1 Nutrient Value

Biosolids contains all the 16 plant macro- and micro-nutrients essential for plant growth: carbon, oxygen, hydrogen, nitrogen, potassium, calcium, magnesium, phosphorus, sulfur, chlorine, iron, boron, manganese, zinc, copper, and molybdenum. Some plants require other elements, or may store additional elements needed by the animals that feed on plants. These elements include cobalt, sodium, silicon, selenium, nickel, chromium, and vanadium. Biosolids also contains these elements. Of these, the most important nutrient for a forest fertilizer in western Washington is nitrogen.

Biosolids nitrogen generally averages about 7%, primarily in an organic form with a smaller portion in mineral forms (ammonia-nitrogen, nitrate-nitrogen). The mineral nitrogen is rapidly available for plant use, much like commercial fertilizer. The remaining nitrogen is bound in a complex of organic matter and is only available for plant use as it is slowly mineralized by soil microorganisms into mineral form. This process makes biosolids an excellent fertilizer, as it releases nutrients over a period of time at a rate, which meets plant needs. This slow release process minimizes the likelihood of nutrients leaching out of the root zone.

### 3.2 Trace Metals and Organic Compounds

Trace metals and organic compounds found in King County biosolids are listed in the county's *Annual Biosolids Quality Summary*. Some of the metals contained in biosolids are essential for plant growth; these micronutrients include iron, copper, manganese, and zinc. Other elements are relatively immobile in the soil and remain in the surface soil after application, such as nickel, cadmium, and lead. The forest soils in western Washington already contain all the metals and nutrients found in biosolids. The amount added with applications of biosolids is very small compared to the amounts naturally present in the soil horizons.

Trace organics found in biosolids remain in the soil where some are degraded by soil microorganisms. The amounts found in biosolids are far less than the levels that would cause harm to humans or the environment, according to risk assessments conducted by the US Environmental Protection Agency. Trace

organics are generally insoluble and are not readily taken up by plant roots and do not pose a significant food chain risk.

### 3.3 Microorganisms

Untreated or raw wastewater solids may contain bacteria, viruses, and protozoa, including potential pathogens (disease-causing organisms). During the treatment process beneficial microorganisms are encouraged to multiply by maintaining appropriate temperature and other environmental conditions. These beneficial microorganisms digest and thereby stabilize the organic matter, including other microorganisms that comprise the biosolids. This digestion and stabilization process destroys ninety-five percent or more of the pathogens in dewatered biosolids. After land application, any remaining pathogens are exposed to sunlight, unfavorable temperatures, and populations of native soil microorganisms, which further reduce their numbers. Because of the efficiency of the treatment processes, King County's biosolids from its secondary treatment plants currently contain no detectable viruses or parasites and few to no pathogenic bacteria.

## 4.0 SITE SELECTION

The program partners will select sites that are well suited for biosolids where trees are likely to respond well. All the program partners must approve each site: the state DNR, King County, and the University of Washington. Sites are initially screened in the office with topographic maps, soil maps, recent aerial photos, and inventory records. A careful walk-through is performed on each potential site to confirm its suitability according to the criteria listed below:

### 4.1 Terrain

For ground application, equipment is limited to slopes of 30 to 40%, and ideally, slopes of 15% or less. Slope allowances for forestry sites are higher than those allowed for agriculture due to the infiltration capacity of the forest floor and the ability of the understory foliage to intercept the biosolids and aid stabilization and drying. The state Biosolids Management Guidelines (BMG) provide a ranking system for evaluating slopes and site continuity, with rolling to level sites given the highest ranking. The guidelines also recommend that only dewatered biosolids be used on slopes of 30-60% with good vegetative cover. King County's biosolids has proven to be stable on well-vegetated slopes exceeding 50% at the Snoqualmie Tree Farm and during research and operations conducted by the University of Washington at Pack Forest in Eatonville, Washington. Since the applicator vehicle cannot travel on this degree of slope, when biosolids are applied to steeper slopes, they will be flung from the road.

## **4.2 Soils and Groundwater**

The best soils for biosolids are those that have a high content of gravel and sand, minimal amounts of clay and a restrictive layer that is deep or absent. These coarse-textured soils work best for two reasons: (1) they can withstand the impact of the loaded application vehicles, even during wet winter weather and (2) they are low in nutrients and need extra nitrogen and organic matter. The best tree growth response will be on sites with these medium to poor quality soils.

During the wet winter months, only well-drained soils without a till or shallow restrictive layer will receive biosolids. This practice ensures that sites with a high seasonal water table are not fertilized when water is present within 2 to 3 feet of the surface. Till or residual (bedrock) soils may receive biosolids during the dry season

## **4.3 Vegetation**

Applications are made only to those plantations that are well stocked and have few brushy and treeless pockets. The trees must be at least five feet tall. At this height they are tall enough to withstand competition from fertilized undergrowth. At five feet, the tree's leader (leading shoot) is safer from being clipped off by browsing deer. Plantations shorter than 5 feet can be damaged by the deer who prefer feeding on fertilized trees.

## **4.4 Surface waters**

The most desirable sites are those with large expanses of well-drained soils, unbroken by surface water bodies. Sites with many draws, streams and wetlands may require a larger proportion of the area in setbacks or buffers, thus reducing the net usable area for application.



#### **4.5 Road System**

In order for haul trucks to deliver to the sites, grades should not exceed 10% for long distances and the roads must have frequent turnouts or be wide enough to allow two trucks to pass each other. Some portions of DNR road systems do not meet these requirements. If necessary, traffic will be managed by flaggers to allow for safe passage of pedestrians, bicyclists, and vehicles.

### **5.0 FERTILIZER RATES**

Soils may provide all the elements known to be essential for plant growth. However, forest soils can be deficient or depleted of some of these nutrients. In western Washington forests, soils are particularly deficient in nitrogen. The addition of biosolids can provide sufficient nitrogen for tree growth, as well as many other essential macro- and micro-nutrients (such as sulfur, potassium, and zinc). Applications also can increase the organic matter content of the soil. Organic matter is important in improving the soil aggregation and the soil's moisture retention and nutrient-holding capacity.

#### **5.1 Nitrogen Prescription**

Researchers from the University of Washington College of Forest Resources determine the amount of biosolids to be applied for each unit. It is the nitrogen (N) in biosolids that restricts application rates. Of all the nutrients in biosolids, nitrogen is the potential polluter of surface and ground waters if over-applied. The N prescription or design rate is a theoretical calculation of the amount of N used and stored by various portions of the forest ecosystem. This rate is designed to minimize excess N.

Biosolids contain inorganic (ammonia) and organic N and, therefore, both volatilization of ammonia and mineralization of organic N must be considered when determining application rates. Volatilization (loss of ammonia to the atmosphere) during and shortly after application will decrease the amount of plant-available nitrogen. Mineralization (release of organic nitrogen through decomposition) slowly increases the amount of plant available nitrogen in the soil. Temperature, moisture, soil microorganisms, and pH affect the rate of mineralization.

The calculation of the appropriate N rate involves an analysis of the N supplied by biosolids, the mineralization and volatilization rates of biosolids, the nutrient uptake of the trees and understory, and capacity of the soil to store nitrogen.

Based on the above method to determine fertilizer requirements, application rates for state forests will usually vary from

approximately 3 to 7 dry tons (DT) of biosolids per acre (15 to 35 wet tons per acre at 20% solids). The lower rates apply to older stands of timber with little understory; the higher rates are appropriate for fully stocked, vigorously growing plantations. The higher rate translates to approximately 800-850 pounds per acre of *total* nitrogen and 300-330 pounds per acre of *available* nitrogen. Another reason for variation in rates is variation in the N content of the biosolids from year to year.

Each unit or stand will have its own unique nitrogen application rate, prescribed before application of biosolids, so that the evaluation is based on current understory and stand conditions. See Appendix B for a sample spreadsheet with application rate calculations.

## 6.0 OPERATIONS

The following section describes how biosolids will be transported, stored and handled on-site, including applications, buffer areas and environmental monitoring. Appendix B contains the forms and logs used in operations, plus the signs posted at each site. Also in Appendix B is a description of roles and responsibilities of project staff, contractors and cooperators in state forest projects.

### 6.1 Site Design

After King County, DNR, and the UW have evaluated a prospective site, the field design begins. Contract foresters, under the direction of King County staff, thoroughly examine the site, eliminating areas that are too steep, too wet or otherwise unsuitable for biosolids fertilization. Boundaries of the usable area are marked in the field with fluorescent flagging. Then the forester designs a system of parallel, looping or dead end trails which will allow the applicator vehicle to completely reach all the usable area. The ideal is to have slightly overlapping, even coverage of each compartment from trails on either side. However, a skilled operator can also achieve even coverage from a one-way throw. The spacing between application trails varies from 260 feet in young plantations to 120 feet in timber. See Appendix F for copies of specific trail maps.

#### 6.1.1 Buffers

Buffers protect streams, wetlands and other surface waters in or adjacent to the application area. Buffers (or setbacks) are strips of land of varying widths that do not receive biosolids. The purpose of buffer areas is to provide a protected zone around roads and sensitive areas and to provide a safety margin if an operator were to overshoot the boundaries. They provide additional land for filtering and using biosolids constituents. Buffers are site-specific and are marked on the trail maps.

Steep slopes and other non-application areas are usually also labeled as "buffers" on the trail maps.

The federal and state biosolids rules require minimum setbacks of 10 meters (approx. 33 feet). Buffers on state forests will be at least 33 feet, and usually larger than this, depending on the location of the stand edge, riparian vegetation, moist soils, and ephemeral waterways. Larger buffers may also be used where the public or landowner wants to set back from certain features. Ecology's guidelines for buffers from water range from 33 feet to 200 feet depending on type of water body. Buffers that are appropriate for dewatered biosolids and for each site's features will be shown on each trail map.

## 6.2 Site Preparation

Before biosolids are applied, trails are constructed and mapped and each compartment's loads calculated to provide the amount of nitrogen prescribed by the University of Washington. Access restriction signs will be put in place before application begins.

### 6.2.1 Trail Construction

The Rottne forwarder is designed for off-road work in forest stands and does not need a graded surface for travel. When operating as a biosolids applicator vehicle in young plantations, however, it must follow the designated trails and will encounter some obstacles such as large stumps and debris piles from past harvest operations. To remove these obstacles, a tracked excavator is brought into the unit to pick up and clear large debris piles in the trails. The operator makes every effort to reduce impact to the ground and preserve as many plantation trees as possible.

### 6.2.2. Compartment Design and Tracking

After the trails are cleared, the field forester makes a survey of the trail network, creates a map and calculates the acreage in each partition, or compartment, of the unit. (Sometimes the survey is conducted during the design phase, before construction. It has been demonstrated that the calculated acreage does not vary significantly with either method.) Each compartment is numbered and marked on the map. The compartments and acreage are listed on the unit tracking form (see Appendix B), where the prescribed nitrogen rate is translated into tons of biosolids needed, and number of applicator loads needed per compartment.

### 6.2.3. Access Restriction Signs

King County biosolids undergo anaerobic digestion at the treatment plant to significantly reduce pathogens. Because there may be some residual organisms that will die off during transport and exposure to the forest environment, federal regulations require the site to be closed to the public for a period of 30 days. Yellow signs, approximately 5 by 7 inches, are posted on trees and stumps around the perimeter of the unit every 100 feet, or at whatever spacing will give good visibility given the conditions and location (see Appendix B).

## 6.3 Transportation

Dewatered biosolids can be hauled in standard or modified haul trailers and handled in modified manure-spreaders. The consistency of the material is similar to wet peat moss and can be applied during both dry and wet weather. Dewatered biosolids are stable and do not liquefy, run or move from storage or application areas. Haul trucks deliver a daily supply of biosolids directly to areas that are being fertilized.

### 6.3.1 Biosolids Delivery

Biosolids will be transported by the contractor to the site in covered 33-ton, dump truck-pup trailer trucks with rubber-sealed rear gates. In situations where grades are adverse and too steep for the truck-trailer combination to climb, the trailer may be unloaded at an accessible site where biosolids will be reloaded into another dump truck and delivered to the application site.

Because of the quantity of biosolids to be applied during the summer application window – August, September and October – the workweek may be extended to seven days. An average of five haul trucks may deliver to the site each day, between approximately 6:30 a.m. and 4 p.m. On a short-term basis, under unusual circumstances such as the cleaning of a digester, up to eight trucks a day may be brought to these sites.

Transportation is provided under contract through a private firm, Great Western Soil Conditioners, and is governed by the *Biosolids and Grit Haul Driver's Manual*. This handbook addresses all aspects of the haul route, emergencies and clean-up equipment in the event of a spill, etc. Copies are available from King County and are located in each haul vehicle and with field personnel.

### 6.3.2 Transfer and Storage Areas

Biosolids will be delivered directly to staging or transfer sites near specific application units. The transfer sites will be road intersections or road spurs adjacent to the application areas. Trailers will unload into the transfer bin from which the applicator self-loads. After the trailers are unloaded, the driver will clean off the back of the trailer to remove any biosolids. This prevents biosolids from being tracked onto forest roads.

The transfer bin consists of an open steel box. The dimension of the base is approximately 16 feet wide by 40 feet long. The walls are three feet high. The transfer bin is modular and stacks together for easy relocation to the next staging area. Biosolids will be loaded into the Aero-Spread applicator box by a clam bucket attached to the applicator vehicle for self-loading.

Transfer sites are intended for short-term, daily storage. Occasional overnight storage may occur when sufficient biosolids are not available on a daily basis for application, or to allow early morning operations. Odors adjacent to transfer sites are minimal and range from almost non-existent to a mild ammonia-like or musty organic odor. Transfer sites will be returned to original or improved condition after use.

## 6.4 Application Equipment

The application vehicle is able to apply biosolids uniformly and in a manner suitable for the terrain. Current equipment consists

of an Aero-Spread box and spreader mounted to the rear of a Rottne log forwarder.

The Aero-Spread is a 17-yard capacity open hopper with a side discharge chute at the rear of the box. Highway Equipment Company in Cedar Rapids, Iowa manufactures it. A chain conveyor in the bottom moves the biosolids to the back, where they are pushed out of the box and into a chamber containing a rotating disk with three paddles. As the disk rotates, the biosolids are flung out the chute and into the application area, up to 200 feet away. Changing the angle of ejection and the velocity of the rotator blade controls the distance of throw.

The carrier vehicle for the Aero-Spread is a log forwarder manufactured by Rottne of Sweden. It is an 8-wheel-drive off-road vehicle with articulated steering and a payload capacity of 17 tons. It is rubber-tired with wide profile tires, which reduce ground pressure. To further reduce ground pressure and to improve traction, chains and tracks can be added to the front and rear tires. The Rottne's grapple/bucket is used to load the biosolids into the Aero-Spread.

## 6.5 Application Method

When biosolids are delivered and unloaded into the transfer bin, the operator pulls the application vehicle alongside and loads the spreader box. Each applicator load contains about 16 tons of biosolids. Each set of double trailers contains about 33 tons of biosolids, enough to provide approximately 2 applicator loads.

The operator drives the filled applicator into the unit along trails that have been prepared by the excavator. A trail map and log sheet, which specifies the number of loads needed for each compartment, is kept in the cab of the applicator. After each load is evenly spread, the operator records the load and date applied (see form in Appendix B).

The trail map indicates buffers and other attributes of the particular unit. Buffers and boundaries are also marked in the field with flagging, so the operator can clearly see which areas are to receive biosolids.

The application contractor performs routine equipment maintenance and cleaning. King County's site manager can suspend applications if weather or soil conditions make operations infeasible or unsafe, conditions such as severe winds, extremely wet soil conditions, frozen ground or accumulation of snow. Applications to young plantations will also be suspended from late May through mid July when trees are extending new terminal shoots which can be easily broken by biosolids applications.

## 6.6 Monitoring

The King County Biosolids Program monitors its operations to ensure compliance with permit specifications, state biosolids management guidelines, and with its own standards for field operations. The King County Environmental Laboratory is responsible for water quality monitoring and analysis of samples. The College of Forest Resources, University of Washington, has the ultimate oversight role, reviewing and approving site operations, monitoring, and analysis results. See Appendix C for a more detailed description of monitoring parameters, frequencies and sampling protocols.

### 6.6.1 Operations Monitoring

The contract/operator keeps a log of daily operations, including records of applications and any operational difficulties and their solutions. The King County site manager is on site daily to oversee operations, as well as review daily and weekly reports prepared by operations personnel. The following procedures are used to control the operation:

- a. The application contractor records the tons of biosolids (provided on the load ticket from the treatment plant) on the weekly site log. Each month, King County staff reconciles the delivery records with the records from the treatment plant and the haul contractor. The weekly site log also contains the final destination, by unit, of the biosolids in each truckload.
- b. The trail map delineates application compartments, buffer zones, waterways and other significant features for each application unit or area. The compartment numbers correspond to the compartments listed on the log and tracking sheets.
- c. Individual tracking sheets for each unit (Appendix B) list application rates in dry tons and the corresponding applicator loads of biosolids needed for each compartment found on the trail map. The field log, carried in the cab of the application vehicle, also lists the number of loads needed for each compartment. Each load applied is recorded in the field log along with the date.
- c. The contractor and King County site manager conduct visual inspections during operations. Application areas and rates, buffer zones, roadways and transfer areas will be checked as applicable.
- d. Applications will be checked and adjustments to equipment will be made to meet the target application rate as closely as possible.

### 6.6.2 Environmental Monitoring

Environmental monitoring is performed to establish the existing conditions/levels of indicator parameters (such as nitrogen and bacteria) in the streams draining the application areas and to track these after applications. Water quality sampling and analysis is performed by King County's Environmental Laboratory, in accordance with standard laboratory protocols. Soil samples are collected by the project team and analyzed at a contract laboratory. The following is a brief overview of the parameters and frequencies for the soils and water monitored within the project area. For a more detailed description see Appendix C.

- a. **Soil** samples that are representative of the project area will be collected before application to assess existing soil conditions, including existing concentrations of organic matter, nutrients and metals.
- b. **Surface waters/streams** will be monitored at sampling stations downstream from project areas and at control stations upstream, if feasible. Routine monitoring will occur quarterly; the major parameters analyzed are nitrate, ammonia, fecal coliform, and Enterococcus bacteria. Temperature and pH are also measured in the field. In addition, two storms are sampled the year following application: a major fall rainstorm and one in the early spring
- c. **Groundwater** may be sampled if there are domestic wells within one-quarter mile and down gradient of the project area. Domestic wells are generally distant from state forest application sites and most of the sites do not overlie aquifers of any significant size. For these reasons, groundwater sampling is not a part of the monitoring program in state forests.
- d. On appropriate sites, **tree growth** response may be monitored via growth plots installed and measured by the Stand Management Cooperative. This research organization gathers data throughout the northwest on forest stand response to various spacing, pruning, thinning and fertilization treatments. King County, DNR and UW are members of the Coop. Monitoring by the Coop ensures professional, consistent methods and the ability to compare results with that of urea fertilization.

## 6.7 Research

The application techniques used in this program are based on: (a) research and demonstrations conducted since 1973 by the University of Washington College of Forest Resources (UW CFR) at Pack Forest, Eatonville, Washington and at operational sites,



and (b) biosolids applications by King County at the Snoqualmie Tree Farm since 1987. In addition to overseeing the continuing applications and monitoring, the UW CFR will design and conduct research on DNR lands throughout the life of the program. This research will address specific operational questions or gaps in present knowledge. One area of research in the Lake Sammamish watershed evaluated the behavior of various forms of phosphorus in soils and streams of biosolids application areas. Annual surveys of benthic invertebrates have been done in order to document conditions associated with the UW Index of Biotic Integrity.

## 7.0 PUBLIC INVOLVEMENT PLAN

During the development of the Biosolids Forestry Program as proposed by MTS GT, there was a considerable effort to provide information to the general public, local agencies, and media about biosolids recycling and the proposed application program. MTS GT representatives, with assistance from King County and DNR, met with local community, recreational and environmental groups concerning the project. *The Issaquah Press*, *Snoqualmie Valley Reporter*, *Snoqualmie Valley Record* and *Eastside Journal* (formerly *Journal American*) all reported on the first biosolids applications.

During and after the first project at Tiger Mountain, an interpretive sign (approximately 24" x 36") was posted for general information about biosolids recycling and its role in DNR's working forests. Opportunities for on-site tours at all current sites will be provided to further encourage public involvement.

## 8.0 RECORDKEEPING AND REPORTS

Records will be maintained in King County databases of pre- and post-application monitoring data, application areas and acreage, and application rates (in dry tons/acre, wet tons/acre). All site logs and other records are kept on file at King County's King Street Center offices (see examples in Appendix B). Records are available to the public and regulators upon request. Application summary information is included in King County's annual reports to Ecology and the Environmental Protection Agency in accordance with requirements of biosolids management regulations.

## 9.0 CONTINGENCY PLANS

The haul contractor, Great Western Soil Conditioners, Inc. of Tumwater, Washington, will handle any incidents during the transport and unloading of biosolids. The applications contractor, RAMCO, INC, will manage incidents or problems occurring after the delivery of biosolids, during transfer or application. Both contractors have many years of experience in the haul and application of King County biosolids. Emergency procedures are outlined in their respective contracts and in the handbooks discussed below.

### 9.1 Procedures for Haul Contractor

All incidents will be managed according to the *Biosolids & Grit Haul Driver's Manual* to minimize or eliminate hazards to operations personnel, the environment, and the public. This manual addresses all aspects of an emergency including haul routes and clean-up equipment in the event of a spill, etc. Copies are available from King County and are located in each haul vehicle and with field personnel. A brief summary of the required procedures is listed below.

The Great Western dispatcher is accessible 24 hours a day, 7 days a week by phone or pager. Drivers can contact the base station by either two-way radio or cellular telephone. Trucks are also equipped with CB radios, which allow the driver to maintain contact with other vehicles in the vicinity and with the application contractor at the site.

If a driver has a material spill or is involved in an accident, the driver shall radio the Great Western dispatcher who will notify King County immediately and then coordinate emergency assistance and, as appropriate, notify the regulatory agencies.

Any spill requires immediate response by the driver. Small spills may require only a shovel; major spills, which cannot be cleaned up by the driver within 15 minutes, may require a variety of equipment such as tow trucks, cranes and vacuum trucks. The handbook lists the cleanup subcontractors to be contacted in each area of the state. An Incident Spill Report (see Appendix B) will be filed with King County as soon as possible.

### 9.2 Procedures for Applications Contractor

After biosolids have been delivered into the transfer bin, the application contractor, RAMCO, Inc., (referred to as "Contractor" in the following sections), is responsible for proper application of the material. Incidents that could occur during application include spilling from the applicator,

applying in the wrong areas, overshooting boundary or buffer lines, or applying more than the prescribed rate.

### 9.2.1 Small-Scale Incidents

These are defined as small spills, overspray and minor vehicle incidents. The contractor is to follow these steps:

- The individual involved resolves the situation and files a report with the Contractor as soon as practical that day.
- The Contractor includes these reports in the daily briefing with the King County Site Manager (Doug Newlands).
- The King County Site Manager inspects all small-scale incidents within 24 hours.
- The King County Site Manager describes these incidents and their resolution in his reports to the King County Project Manager (Roberta King).

### 9.2.2. Large-Scale Incidents

These incidents involve large amounts of biosolids, vehicle accidents with significant damage, or errors in application that threaten surface water quality.

- The operator immediately ceases operations and notifies the Contractor.
- If there are no injuries and the risk of offsite impacts is not immediate, the Contractor contacts the King County Site Manager to devise a remedial action plan.
- If there is high risk of immediate offsite impact, any injuries, or involvement of persons who are not part of the biosolids operations, the Contractor directs immediate remedial actions (e.g., First Aid, containment/cleanup). Then the Contractor immediately contacts the King County Operations Manager.
- If biosolids have the potential to immediately and directly enter any surface water body, the Contractor shall immediately take all feasible measures to prevent this. This may include but not be limited to mobilization and use of the application vehicles, other equipment, erosion control equipment and additional personnel.
- The King County Site Manager contacts the King County Project Manager (Roberta King) or King County TARR Supervisor (Peggy Leonard) immediately.

For any spill that may threaten water quality, the King County Site Manager notifies Environmental Lab Trouble Call Coordinator. The King County Project Manager will notify the DNR Project Manager and regulatory agencies.

A complete written report of the incident is prepared by the Contractor and submitted to King County project personnel within one week of the incident. Follow-up reports are submitted, as they are needed.

### 9.2.3 Emergency Contacts

	<u>Work</u>	<u>Home</u>	<u>Pager*</u>
Application Contractor			
Forestry Site Manager			
Forestry Project Manager			
Technology Assessment Resource Recovery Supervisor			
Haul Contractor/Dispatcher			
Biosolids Haul Coordinator			
King County Environ. Lab Trouble Call Coordinator			
DNR Project Manager			

\*To activate pagers (touch tone phones only), call the listed number; at the end of the beep, quickly enter your phone number; this will cause your number to be displayed on the pager.

Local Cleanup Contractors Available: <u>Hours</u>	<u>Days</u>	<u>After</u>
<u>Dump Trucks/Loaders</u>		
TJ's Services, Issaquah	425.392-1591	425.392.5510
Great Western	360.754.3722	360.943.4923
<u>Vacuum Trucks</u>		
Northwest Enviroservice	206.622.1090 (24 hours)	
Burlington Environmental	206.622.3400 (24 hours)	
<u>Tow Trucks</u>		
Clark Towing	425.392.6000 (24 hours)	
<u>Cranes</u>		
Ness Cranes	206.784.1054	
Mobile Crane	206.767.4767	

For a more complete listing, see the *Biosolids & Grit Haul Driver's Manual*.